Basic Characteristics Data

Model	Circuit method	Switching frequency [kHz] (reference)	Input current [A]	Inrush current protection	PCB/Pattern			Series/Parailel operation	
					Material	Single sided	Double sided	Series operation	Parailel operation
BRFS30	Buck Converter	300	✻1	-	glass fabric base,epoxy resin	-	Multilayer	-	✻3
BRFS40	Buck Converter	300	✻1	-	glass fabric base,epoxy resin	-	Multilayer	-	✻3
BRFS50	Buck Converter	300 ✻2	✻1	-	glass fabric base,epoxy resin	-	Multilayer	-	✻3
BRFS50L	Buck Converter	300 ✻2	✻1	-	glass fabric base,epoxy resin	-	Multilayer	-	✻3
BRFS60	Buck Converter	300 ✻2	✻1	-	glass fabric base,epoxy resin	-	Multilayer	-	✻3
BRFS100	Buck Converter	300 ✻2	✻1	-	glass fabric base,epoxy resin	-	Multilayer	-	✻3

✻1 Refer to Specification.
✻2 BRFS50,50L,60 and 100 has 2 Phase Interleaving inverters, the frequency of ripple is 600kHz.
✻3 Refer to the Instruction Manual.

1 Pin Configuration BRFS-8

2 Connection for Standard Use BRFS-8

3 Wiring Input / Output Pin BRFS-9

3.1 Wiring input pin BRFS-9
3.2 Wiring output pin BRFS-9

4 Function BRFS-10

4.1 Overcurrent protection BRFS-10
4.2 Thermal protection BRFS-10
4.3 Remote ON / OFF BRFS-10
4.4 Remote sensing BRFS-10
4.5 Adjustable voltage range BRFS-10
4.6 Softstart/Start-up sequence BRFS-11
4.7 Power good BRFS-12
4.8 Sequence BRFS-12

5 Series and Parallel Operation BRFS-12

5.1 Series operation BRFS-12
5.2 Parallel operation BRFS-12

6 Implementation・Mounting Method BRFS-13

6.1 Mounting method BRFS-13
6.2 Automatic mounting BRFS-13
6.3 Soldering BRFS-13
6.4 Cleaning BRFS-13
6.5 Storage method BRFS-13

7 Safety Considerations BRFS-14

8 Derating BRFS-14

8.1 BRFS series Derating BRFS-14

9 Package Information BRFS-15

1 Pin Configuration

Table 1.1 Pin connection and function of BRFS30/40

Pin No.	Pin Connection	Function
①	RC	Remote ON/OFF
②	+VIN	+DC input
③	SEQ	Control of Start up time and turn
④	GND	GND (-DC input, -DC output)
⑤	+VOUT	+DC output
⑥	TRM	Adjustment of output voltage
⑦	+S	+Remote sensing
⑧	GND	GND (-DC input, -DC output)
⑨	NC(PGOOD/ SHARE)	NC (optional : Power good (BRFS30/40), SHARE (BRFS40)
⑩	SGND	SGND (-DC input, -DC output)

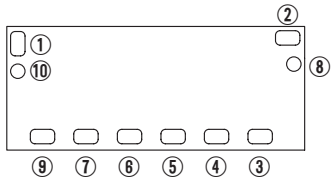
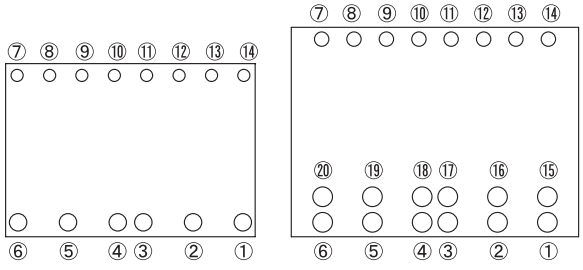


Fig.1.1 Pin connection of BRFS30/40 (BOTTOM VIEW)

Table 1.2 Pin connection and function of BRFS50/50L/60/100

Pin No.	Pin Connection	Reference
① ⑮	+VIN	+DC input
② ⑯	GND	GND (-DC input, -DC output)
③ ⑰	+VOUT	+DC output
④ ⑱	+VOUT	+DC output
⑤ ⑲	GND	GND (-DC input, -DC output)
⑥ ⑳	+VIN	+DC input
⑦	SEQ	Control of Start up time and turn
⑧	PGOOD	Power good
⑨	RC	Remote ON/OFF
⑩	-S	-Remote sensing
⑪	+S	+Remote sensing
⑫	+TRM	+Adjustment of output voltage
⑬	-TRM	-Adjustment of output voltage
⑭	SHARE	Parallel operation



(a) BRFS50/50L/60 (b) BRFS100

Fig.1.2 Pin connection of BRFS50/50L/60/100 (BOTTOM VIEW)

2 Connection for Standard Use

■In order to use power supply,it is necessary to wire as shown in Fig.2.1 and Fig.2.2.

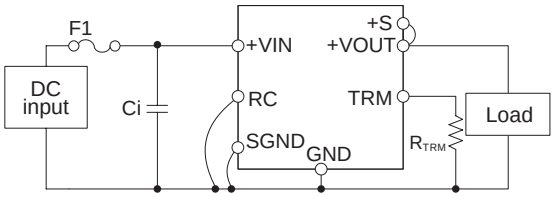


Fig.2.1 Connection for standard use of BRFS30/40

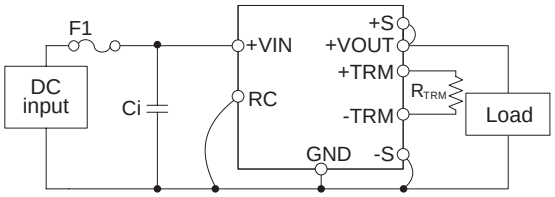


Fig.2.2 Connection for standard use of BRFS50/50L/60/100

〔 Reference 3 "Wiring Input/Output Pin"
8 "Derating" 〕

■Short the following pins to turn on the power supply.
GND↔RC, +VOUT↔+S, GND↔-S (-S : only BRFS50/50L/60/100)

〔 Reference 4.3 "Remote ON/OFF"
4.4 "Remote sensing" 〕

■Connect resistance to set the output voltage between TRM and GND.

〔 Reference 4.5 "Adjustable voltage range" 〕

■Between input and output is not isolated .

■The BRFS series handle only the DC input.
Avoid applying AC input directly.
It will damaged the power supply.

Table 2.1 External parts

No.	Parts	Reference
1	F1:Fuse	3.1(1) External fuse
2	Ci:External output capacitor	3.1(2) External input capacitor
3	R_{TRM}:Resistance for adjustment output voltage	4.4 Adjustable voltage range

3 Wiring Input/Output Pin

3.1 Wiring input pin

(1) External fuse

■Fuse is not built-in on input side. In order to protect the unit, install the normal-blow type fuse on input side.

Table 3.1 Recommended fuse (normal-blow type)

Model	BRFS30/40	BRFS50/50L	BRFS60	BRFS100
Rated current	40A	40A	60A	80A

■When the input voltage from a front end unit is supplied to multiple units, install the normal-blow type fuse in each unit.

■When the fuse is open, power good signal is not outputed.

(2) External capacitor on the input side

■Install an external capacitor Cin, between +VIN and GND input pins for low line-noise and for stable operation of the power supply.

Table3.2 Recommended external input capacitor(Ceramic)

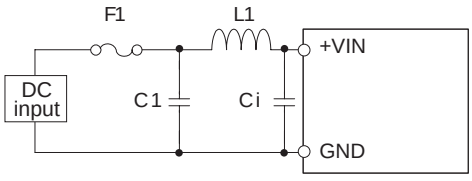
Model	Recommended Ci	
	Vin=5V	Vin=12V
BRFS30/40	8×22μF	4×22μF
BRFS50/50L	8×22μF	4×22μF
BRFS60	8×22μF	4×22μF
BRFS100	8×22μF	4×22μF

■Cin is within 5mm for pins. Make sure that ripple current of Cin is less than its rating.

■When an impedance and inductance level of the input line become higher, the input voltage may become unstable. In that case, the input voltage becomes stable by increasing Cin.

(3) Recommendation for noise-filter

■Install an external input filter as shown in Fig.3.1 in order to reduce conducted noise. Cin is shown in Table 3.2.



C1 :220μF(BRFS30/50/50L)
:470μF(BRFS40/60/100)
L1 :0.3μH

Fig.3.1 Example of recommended external input filter

(4) Reverse input voltage protection

■Avoid the reverse polarity input voltage. It will damage the power supply.
It is possible to protect the unit from the reverse input voltage by installing an external diode as shown in Fig.3.2.

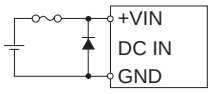


Fig.3.2 Reverse input voltage protection

3.2 Wiring output pin

■When the BRFS series supplies the pulse current for the pulse load, please install a capacitor Co between +VOUT and GND pins.

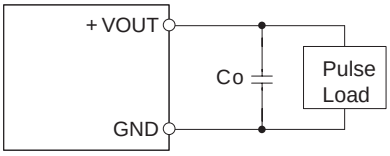


Fig.3.3 wiring external output capacitor

Table 3.3 Recommended Capacitor and max Co

Model	Recommended Co	MAX Co
BRFS30/40	3×100μF	10,000μF
BRFS50/50L	2×100μF	10,000μF
BRFS60	2×100μF	10,000μF
BRFS100	4×100μF	20,000μF

■The output ripple voltage may grow big by resonance with Co and ESL of the wiring, if resonance frequency and switching frequency are close.

■Ripple and Ripple Noise are measured, as shown in the Fig.3.4. Co0, Co1, Co2 and Co3 is shown in Table 3.3.

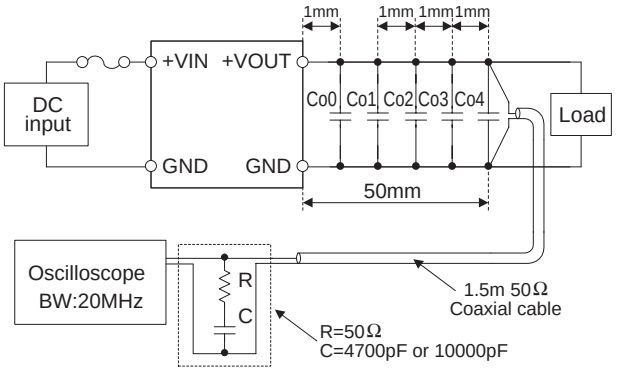


Fig.3.4 Measuring method of Ripple and Ripple Noise

Table 3.4 Co0, Co1, Co2 and Co3 which is used in measuring

No.	Model	Co0	Co1	Co2	Co3	Co4
1	BRFS30	–	–	100μF	100μF	100μF
2	BRFS40	100μF	–	100μF	100μF	100μF
3	BRFS50/50L/60	–	–	–	100μF	100μF
4	BRFS100	–	100μF	100μF	100μF	100μF

4 Function

4.1 Overcurrent protection

■Over Current Protection (OCP) is built-in and works at 105% of the rated current or higher. However, use in an overcurrent situation must be avoided whenever possible.
The output voltage of the power module will recover automatically when the fault causing overcurrent is corrected.
When the output voltage drops after OCP works, the power module enters a "hiccup mode" where it repeatedly turns on and off at a certain frequency.

4.2 Thermal protection

■When the power supply temperature is kept above 120℃, the thermal protection will be activated and simultaneously shut down the output.
The output voltage of the power supply will recover automatically when the unit is cool down.

4.3 Remote ON/OFF

■The remote ON/OFF function is incorporated in the input circuit and operated with RC and GND. If positive logic control is required, order the power supply with "-R" option.

Table4.1 Specification of Remote ON/OFF

	ON/OFF logic	Between RC and GND	Output voltage
Standard	Negative	L level(-0.2 - 0.6V) or short	ON
		H level(3.0 - VIN) or open	OFF
Optional -R	Positive	L level(-0.2 - 0.6V) or short	OFF
		H level(3.0 - VIN) or open	ON

*Source current from RC pin is 0.5mA(max).

■When remote on/off function is not used, please short GND and RC.

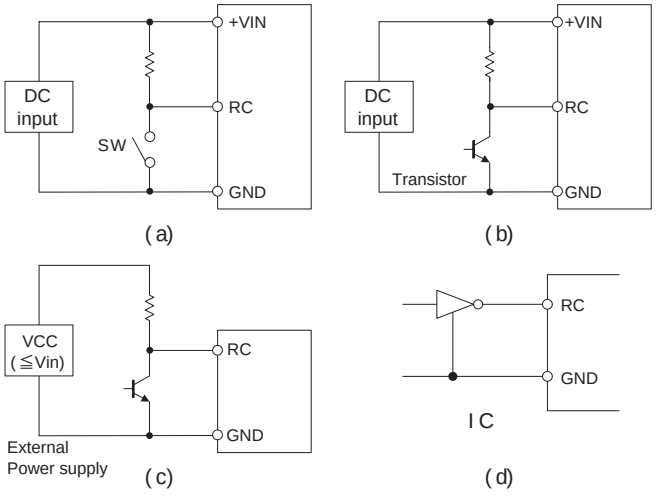


Fig.4.1 RC connection example

4.4 Remote sensing

(1) When the remote sensing function is not in use

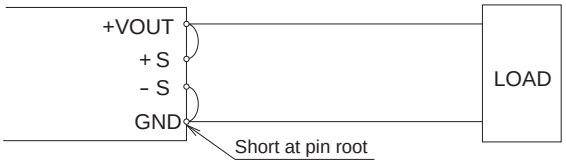


Fig.4.2 Connection when the remort sensing is not in use

■When the remote sensing function is not in use, it is necessary to confirm that pins are shorted between +S & +VOUT and between -S & GND.
■Wire between +S & +VOUT and between -S & GND as short as possible.
Loop wiring should be avoided.
This power supply might become unstable by the noise coming from poor wiring.

(2) When the remote sensing function is in use

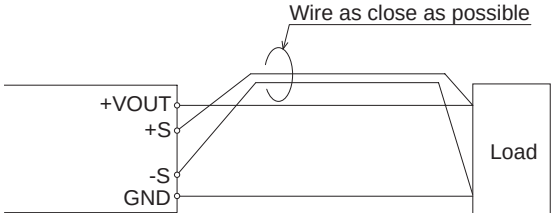


Fig.4.3 Connection when the remote sensing is in use

■Twisted-pair wire or shield wire should be used for sensing wire.
■Thick wire should be used for wiring between the power supply and a load.
Line drop should be less than 0.5V.
Voltage between +VOUT and GND should remain within the output voltage adjustment range.
■If the sensing patterns are short, heavy-current is drawn and the pattern may be damaged.
The pattern disconnection can be prevented by installing the protection parts as close as a load.

4.5 Adjustable voltage range

■Output voltage is adjustable by the external resistor.
■The temperature cofficiect could become worse, depending on the type of a resistor.
Resistor·····Metal film type, coefficient of less than ±100ppm/℃
■When TRM is opened, output voltage is adjusted to the minimum.
■R_{TRM} is calculated in the following expressions.

BRFS30: $R_{TRM} = \frac{8}{VOUT-0.8}[k\Omega]$

BRFS40: $R_{TRM} = \frac{12}{VOUT-0.6}[k\Omega]$

BRFS50/50L/60/100: $R_{TRM} = \frac{14}{VOUT-0.7}[k\Omega]$

Table 4.2 Calculation result of BRFS30

No	VOUT	R_{TRM}
1	0.8	OPEN
2	1.0	40.0kΩ
3	1.2	20.0kΩ
4	1.5	11.429kΩ
5	1.8	8.0kΩ
6	2.5	4.706kΩ
7	3.3	3.2kΩ

Table 4.3 Calculation result of BRFS40

No	VOUT	R_{TRM}
1	0.6	OPEN
2	1.0	30.0kΩ
3	1.2	20.0kΩ
4	1.5	13.3kΩ
5	1.8	10.0kΩ

Table 4.4 Calculation result of BRFS50/50L/60/100

No	VOUT	R_{TRM}
1	0.7	OPEN
2	1.0	46.6kΩ
3	1.2	28.0kΩ
4	1.5	17.5kΩ
5	1.8	12.7kΩ

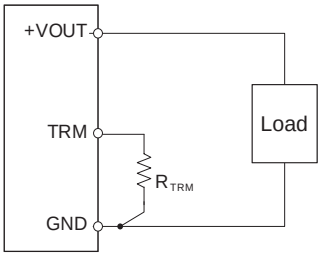


Fig.4.4 Connecting BRFS30/40

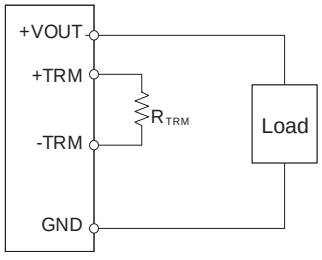


Fig.4.5 Connecting BRFS50/50L/60/100

4.6 Softstart/Start-up sequence

■The adjustment of the rise time is possible by connecting C_{SEQ}.

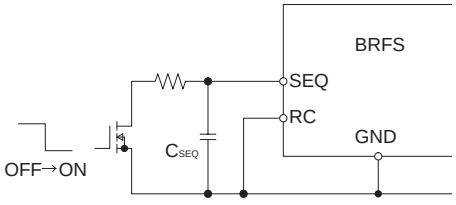


Fig.4.6 Example of soft start circuit

■When the voltage is applied to the terminal SEQ, the output voltage tracks this voltage until the output reaches the set-point voltage. SEQ terminal voltage vs output voltage is calculated the following formula.
Avoid SEQ terminal voltage is set below the set voltage output by Rtrm, the output voltage does not rise to set output voltage. Maximum applicable voltage of terminal SEQ is Vin.When the function is not used, open terminal SEQ.

$$C_{SEQ}\,[\mu F] = (0.284 \div Vo[V] - 0.06) \times T[ms]$$
$$(0.6V \leqq Vo \leqq 2.0V)$$
$$C_{SEQ}\,[\mu F] = (0.284 \div Vo[V] - 0.047) \times T[ms]$$
$$(2.0V < Vo \leqq 3.63V \text{ only BRFS30})$$

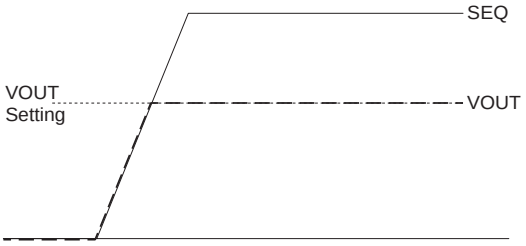


Fig.4.7 SEQ > Vout setting

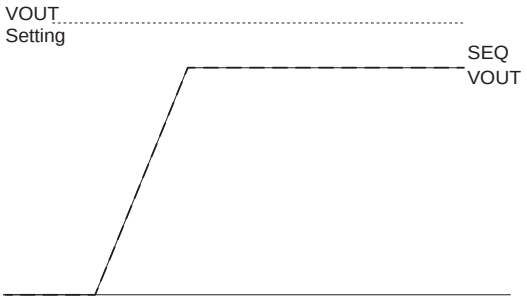
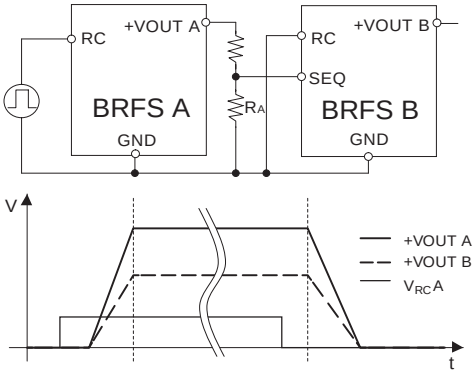


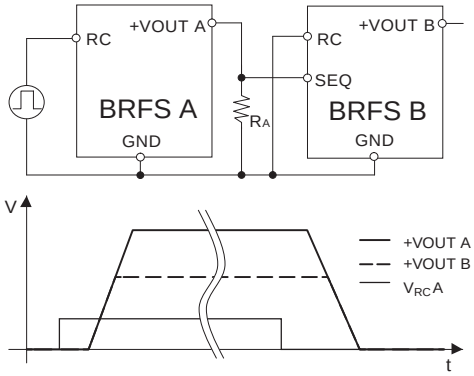
Fig.4.8 SEQ < Vout setting (not recommended)

■With the voltage to input into SEQ pin, you can control a start sequence of plural BRFS.

(a) The same time



(b) The same voltage



(c) The time lag

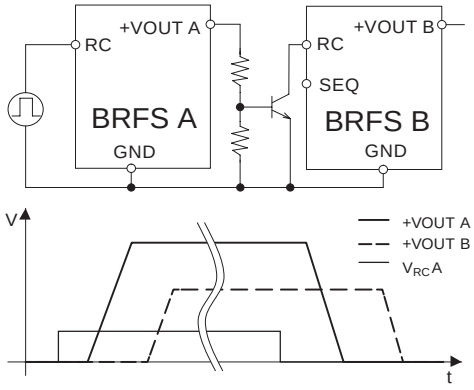


Fig.4.9 Example of sequence control

■If this function is unnecessary, please make SEQ pin open.

4.7 Power good

■By using PGOOD, it is possible to monitor power supply whether normal operation or abnormal operation.

■PGOOD circuit is designed as shown in Fig.4.10.
Sink current of PGOOD is 10mA max.

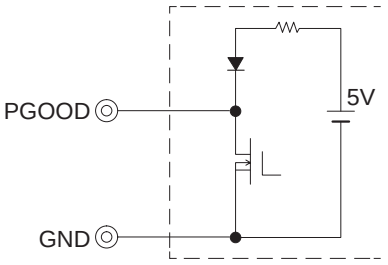


Fig.4.10 Internal PGOOD circuit

■Voltage of PGOOD pin become low when over current protection circuit is work, or output voltage is different from a set point more than ±12.5%.

■If this function is unnecessary, please make PGOOD pin open.

4.8 Sequence

■Fig.4.11 is a sequence chart of each function of BRFS.

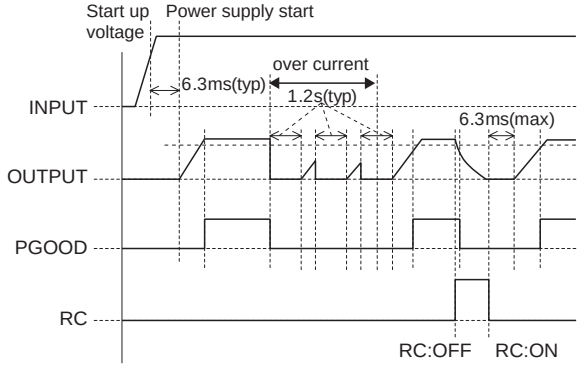


Fig.4.11 Sequence chart of BRFS

5 Series and Parallel Operation

5.1 Series operation

■Series operation is not possible.

5.2 Parallel operation

■Parallel operation is possible BRFS50/50L/60/100 (BRFS30/40 is not possible)

■BRFS40 has a parallel operation “P”.

■In parallel operation, wiring as Fig.5.1

■Make the +S and -S of the slave power supply unconected.

■To improve the load sharing of each unit, use the same length and same wire size from each unit to the load.

■As variance of output current drew from each power supply is maximum 10%, the total output current must not exceed the value determined by the following equation.

(Output current at parallel operation)
=(the rated current per unit)×(number of unit)×0.9

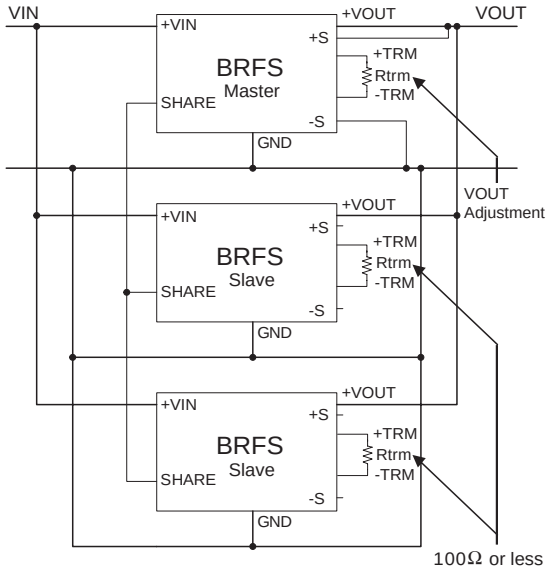


Fig.5.1 Example of wiring method in parallel operation

■Make power supply from the same input power supply.

■Total number of units should be no more than 5 pieces.

■PGOOD of slave power supply output the operating conditions. When power supply is in operation, PGOOD output high level. At the time of stop, it output low level.

■Please connect each other’s SEQ pins if you use SEQ pin.

■Voltage drop from a power supply to the sensing point should be less than 0.2V for stable control.

■Only use RC pin of the master power supply, RC pin of the slave power supply should be short to GND.Or let RC pin’s of the master power supply and the slave power supply short, and please use it.

■If this function is unnecessary, please make SHARE pin open.

■In parallel operation, please use a single model together. When it is necessary to use different model together, please contact us.

6 Implementation・Mounting Method

6.1 Mounting method

■The unit can be mounted in any direction. When two or more power supplies are used side by side, position them with proper intervals to allow enough air ventilation. The temperature around each power supply should not exceed the temperature range shown in derating curve.

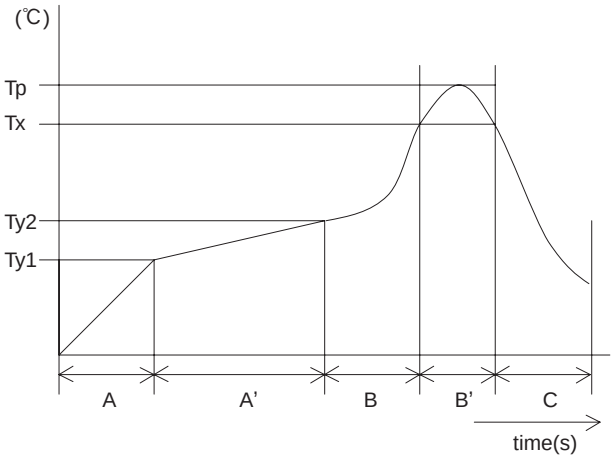
6.2 Automatic Mounting

■To mount BRFS series automatically, use the coil area near the center of the PCB as an adsorption point. Please see the External View for details of the adsorption point.

6.3 Soldering

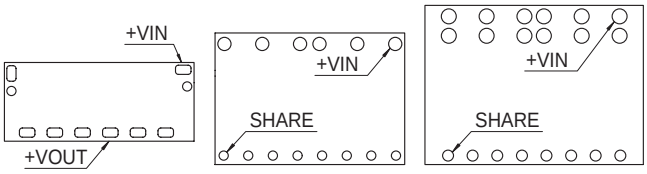
■Fig.6.1 shows condition for reflow of BRFS series. Please make sure that the temperature of pin shown in Fig.6.2 do not exceed the temperatures shown in Fig.6.1.

■While soldering, having vibration or impact on the unit should be avoided, because of solder melting.



A	1.0 - 5.0℃/ s
A'	Ty1 : 160±10℃ Ty2 : 180±10℃ Ty1 - Ty2 : 120s max
B	1.0 - 5.0℃/ s
B'	Tp : Max245℃ 10s max Tx : 220℃ or more : 70s max
C	1.0 - 5.0℃/ s

Fig.6.1 Recommended reflow soldering condition



(a) BRFS30/40 (b) BRFS50/50L/60 (c) BRFS100

Fig.6.2 Measurement point of temperature

■Please do not do the implementation except the reflow.

■Because some parts drops, please do not do reflow of the back side.

6.4 Cleaning

■When cleaning is necessary, clean under the following conditions.

Method : Varnishing, ultrasonic wave and vapor
Cleaning agents : IPA (Solvent type)
Total time : 2 minutes or less

■Do not apply pressure to the lead and name plate with a brush or scratch it during the cleaning.

■After cleaning, dry them enough.

6.5 Storage method

■To stock unpacked products in your inventory, it is recommended to keep them under controlled condition, 5-30℃, 60%RH and use them within a year.

■24-hour baking is recommended at 125℃, if unpacked products were kept under uncontrolled condition, which is 30℃, 60%RH or higher.

Original reels are not heat-resistant. Please move them to heat-resistant trays in preparation to bake.

To check moisture condition in the pack, silica gel packet has some moisture condition indicator particles.

Indicated blue means good. Pink means alarm to bake it.

■The reels will be deformed and the power supply might be damaged, if the vacuum pressure is too much to reseal.

7 Safety Considerations

■To apply for safety standard approval using this power supply, the following conditions must be met.

●This unit must be used as a component of the end-use equipment.

●Safety approved fuse must be externally installed on input side.

8 Derating

BRFS

8.1 BRFS series Derating

■Make sure the temperatures measurement locations shown from Fig.8.2 to Fig.8.6 below are on or under the derating curve in Fig.8.1.
Ambient temperature must be kept at 85℃ or under.

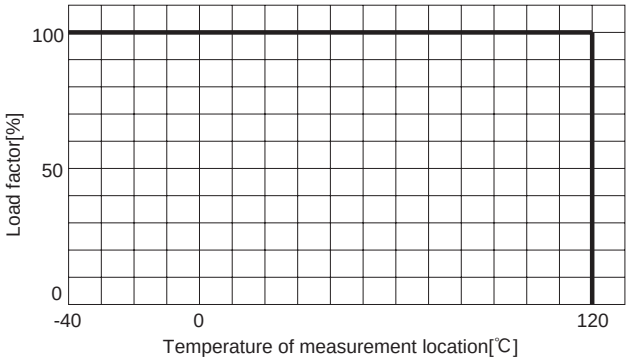


Fig.8.1 Derating curve

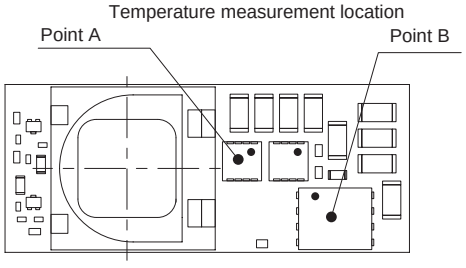


Fig.8.2 Temperature measurement location (BRFS30)

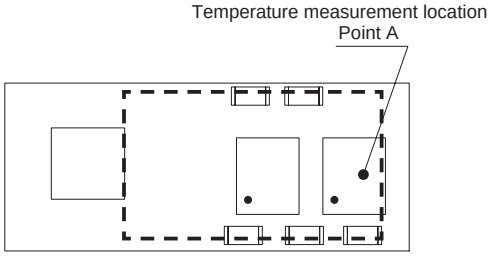


Fig.8.3 Temperature measurement location (BRFS40)

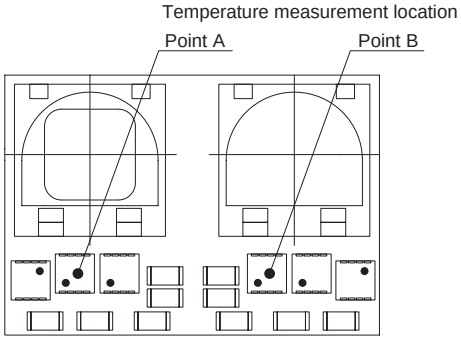


Fig.8.4 Temperature measurement location (BRFS50/50L)

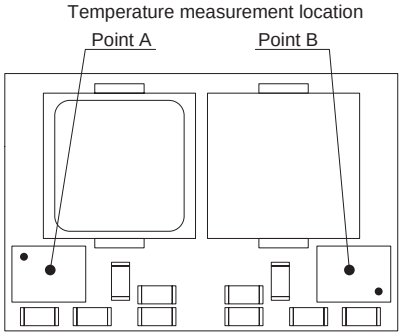


Fig.8.5 Temperature measurement location (BRFS60)

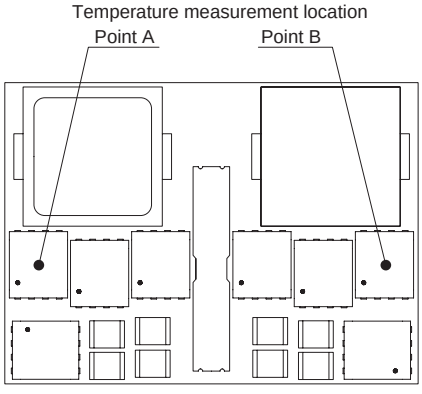
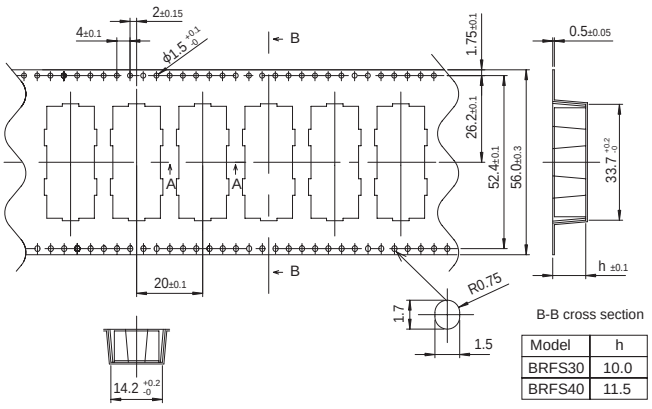


Fig.8.6 Temperature measurement location (BRFS100)

9 Package Information

■Please refer to a Fig.9.1 to Fig.9.4 for Package form (Reel).
■The packed number is 200 (BRFS30/40), 100 (BRFS50/50L/60), 80 (BRFS100).



Model	h
BRFS30	10.0
BRFS40	11.5

Fig.9.1 Taping dimensions of BRFS30/40

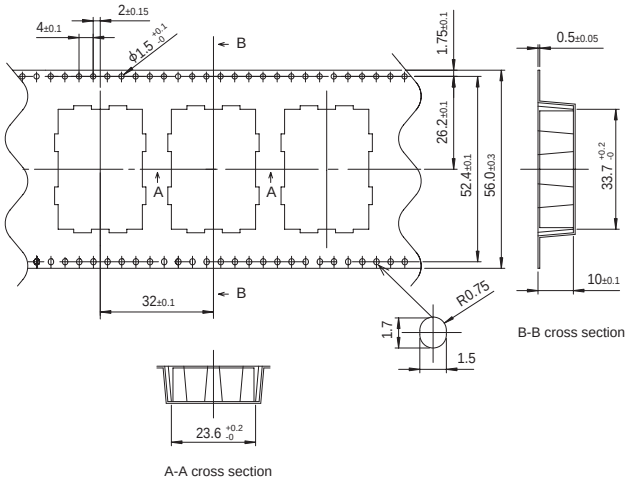


Fig.9.2 Taping dimensions of BRFS50/50L/60

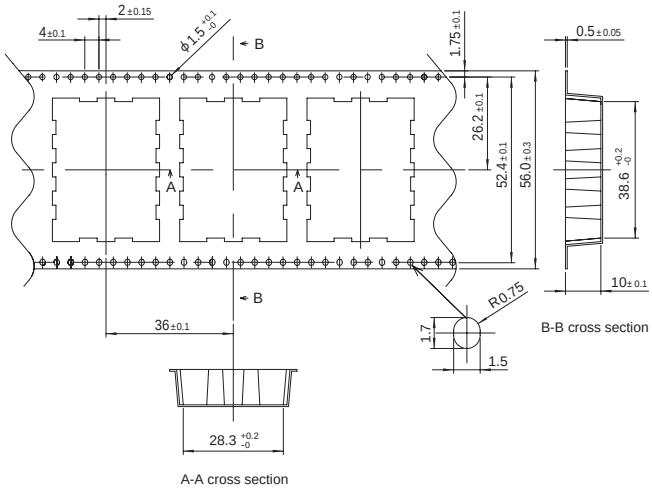
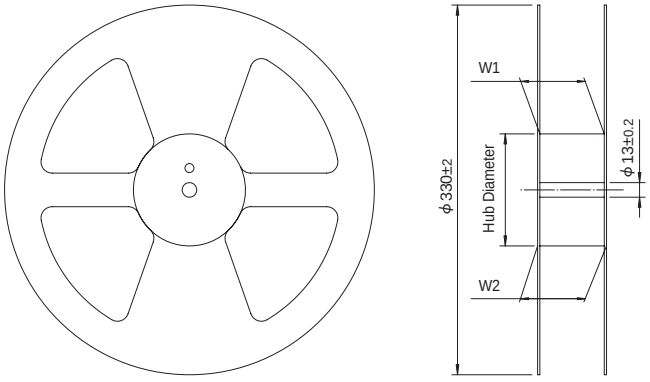


Fig.9.3 Taping dimensions of BRFS100



Model	Tape Width [mm]	Hub Diameter [mm]	W1 [mm]	W2 [mm]
BRFS30/40	56	100	57.4±1.0	61.4±1.0
BRFS50/50L/60	56	150	57.5±1.0	61.5±1.0
BRFS100	56	150	57.5±1.0	61.5±1.0

Fig.9.4 Reel dimensions of BRFS

■Please refer to specifications for the details of package information